



SEQUENCE LISTING

Sheen, Jen
Kovtun, Yelena
Chiu, Wan-Ling

<120> Transgenic Plants Expressing a MAPKKK Protein Kinase Domain

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<140> 10/643,434

<141> 2003-08-19

<150> 09/371,338

<151> 1999-08-10

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<151> 1998-08-10

<160> 24

<170> PatentIn version 3.3

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<223> Oligonucleotide Primer

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27

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<223> Oligonucleotide Primer

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<211> 661
<212> PRT
<213> Arabidopsis thaliana

<400> 7

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Thr Ser Cys Ile Arg Lys Ser Lys Ile Phe Ile Lys Pro Ser Phe Ser
35 40 45

Pro Pro Pro Pro Ala Asn Thr Val Asp Met Ala Pro Pro Ile Ser Trp
50 55 60

Arg Lys Gly Gln Leu Ile Gly Arg Gly Ala Phe Gly Thr Val Tyr Met
65 70 75 80

Gly Met Asn Leu Asp Ser Gly Glu Leu Leu Ala Val Lys Gln Val Leu
85 90 95

Ile Ala Ala Asn Phe Ala Ser Lys Glu Lys Thr Gln Ala His Ile Gln
100 105 110

Glu Leu Glu Glu Glu Val Lys Leu Leu Lys Asn Leu Ser His Pro Asn
115 120 125

Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Asp Asp Thr Leu Asn Ile
130 135 140

Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser Ser Leu Leu Glu Lys
145 150 155 160

Phe Gly Pro Phe Pro Glu Ser Val Val Arg Thr Tyr Thr Arg Gln Leu
165 170 175

Leu Leu Gly Leu Glu Tyr Leu His Asn His Ala Ile Met His Arg Asp
180 185 190

Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys Gly Cys Ile Lys Leu
195 200 205

Ala Asp Phe Gly Ala Ser Lys Gln Val Ala Glu Leu Ala Thr Met Thr
210 215 220

Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp Met Ala Pro Glu Val
225 230 235 240

Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp Ile Trp Ser Val Gly
245 250 255

Cys Thr Val Ile Glu Met Val Thr Gly Lys Ala Pro Trp Ser Gln Gln
260 265 270

Tyr Lys Glu Val Ala Ala Ile Phe Phe Ile Gly Thr Thr Lys Ser His

275

280

285

Pro Pro Ile Pro Asp Thr Leu Ser Ser Asp Ala Lys Asp Phe Leu Leu
 290 295 300

Lys Cys Leu Gln Glu Val Pro Asn Leu Arg Pro Thr Ala Ser Glu Leu
 305 310 315 320

Leu Lys His Pro Phe Val Met Gly Lys His Lys Glu Ser Ala Ser Thr
 325 330 335

Asp Leu Gly Ser Val Leu Asn Asn Leu Ser Thr Pro Leu Pro Leu Gln
 340 345 350

Ile Asn Asn Thr Lys Ser Thr Pro Asp Ser Thr Cys Asp Asp Val Gly
 355 360 365

Asp Met Cys Asn Phe Gly Ser Leu Asn Tyr Ser Leu Val Asp Pro Val
 370 375 380

Lys Ser Ile Gln Asn Lys Asn Leu Trp Gln Gln Asn Asp Asn Gly Gly
 385 390 395 400

Asp Glu Asp Asp Met Cys Leu Ile Asp Asp Glu Asn Phe Leu Thr Phe
 405 410 415

Asp Gly Glu Met Ser Ser Thr Leu Glu Lys Asp Cys His Leu Lys Lys
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Ser Cys Asp Asp Ile Ser Asp Met Ser Ile Ala Leu Lys Ser Lys Phe
 435 440 445

Asp Glu Ser Pro Gly Asn Gly Glu Lys Glu Ser Thr Met Ser Met Glu
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Cys Asp Gln Pro Ser Tyr Ser Glu Asp Asp Asp Glu Leu Thr Glu Ser
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Lys Ile Lys Ala Phe Leu Asp Glu Lys Ala Ala Asp Leu Lys Lys Leu
 485 490 495

Gln Thr Pro Leu Tyr Glu Glu Phe Tyr Asn Ser Leu Ile Thr Phe Ser
 500 505 510

Pro Ser Cys Met Glu Ser Asn Leu Ser Asn Ser Lys Arg Glu Asp Thr
 515 520 525

Ala Arg Gly Phe Leu Lys Leu Pro Pro Lys Ser Arg Ser Pro Ser Arg
 530 535 540

Gly Pro Leu Gly Gly Ser Pro Ser Arg Ala Thr Asp Ala Thr Ser Cys
 545 550 555 560

Ser Lys Ser Pro Gly Ser Gly Gly Ser Arg Glu Leu Asn Ile Asn Asn
 565 570 575

Gly Gly Asp Glu Ala Ser Gln Asp Gly Val Ser Ala Arg Val Thr Asp
 580 585 590

Trp Arg Gly Leu Val Val Asp Thr Lys Gln Glu Leu Ser Gln Cys Val
 595 600 605

Ala Leu Ser Glu Ile Glu Lys Lys Trp Lys Glu Glu Leu Asp Gln Glu
 610 615 620

Leu Glu Arg Lys Arg Gln Glu Ile Met Arg Gln Ala Gly Leu Gly Ser
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Ala Ser Pro Gly Lys
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gagttctacc cttgaaaaag attgtcatct gaagaagagc tgtgatgaca taagtgatat	1320
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aatgagcatg gaatgtgacc aaccttcata ctccaggat gatgatgagc tgaccgagtc	1440
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aagtaacagt aaaagagagg aactgctcg tggtttctcg aaactgcctc caaaaagcag	1620
gtcaccgagt cggggccctc ttggtggttc accttcaaga gcaacagacg caactagttg	1680
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gcttgatcaa gaactggaaa gaaagcgaca agaaatcatg cgccaagcag ggttgggatc	1920
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 <212> PRT
 <213> *Arabidopsis thaliana*

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Val Lys Gln Val Leu Ile Ala Ala Asn Phe Ala Ser Lys Glu Lys Thr
 35 40 45

Gln Ala His Ile Gln Glu Leu Glu Glu Glu Val Lys Leu Leu Lys Asn
 50 55 60

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Asp
 65 70 75 80

Asp Thr Leu Asn Ile Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser
 85 90 95

Ser Leu Leu Glu Lys Phe Gly Pro Phe Pro Glu Ser Val Val Arg Thr
 100 105 110

Tyr Thr Arg Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn His Ala
 115 120 125

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys
 130 135 140

Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala Ser Lys Gln Val Ala Glu
 145 150 155 160

Leu Ala Thr Met Thr Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
 165 170 175

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
 180 185 190

Ile Trp Ser Val Gly Cys Thr Val Ile Glu Met Val Thr Gly Lys Ala
 195 200 205

Pro Trp Ser Gln Gln Tyr Lys Glu Val Ala Ala Ile Phe Phe Ile Gly
 210 215 220

Thr Thr Lys Ser His Pro Pro Ile Pro Asp Thr Leu Ser Ser Asp Ala
 225 230 235 240

Lys Asp Phe Leu Leu Lys Cys Leu Gln Glu Val Pro Asn Leu Arg Pro
 245 250 255

Thr Ala Ser Glu Leu Leu Lys His Pro Phe Val Met
 260 265

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 <213> Arabidopsis thaliana

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 ggataataaa ggatgcatta agcttgctga ttttggtgca tccaacaag tagctgagtt 480
 ggctacgatg actggtgcaa aatctatgaa agggacacca tattggatgg ctccggaagt 540
 tatccttcaa actggacata gcttctctgc tgacatatgg agcgtcggct gtacagttat 600
 tgaaatggtg actgggaagg ctcttgagg tcagcagtat aaagaggttg ctgctatctt 660
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802

<210> 11.
<211> 642
<212> PRT
<213> Arabidopsis thaliana

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Arg Ser Leu Val Phe Arg Ser Thr Thr Asp Asp Glu Asn Gln Glu Asn
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His Pro Pro Pro Phe Pro Ser Leu Leu Ala Asp Lys Ile Thr Ser Cys
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Ile Arg Lys Ser Met Val Phe Ala Lys Ser Gln Ser Pro Pro Asn Asn
35 40 45

Ser Thr Val Gln Ile Lys Pro Pro Ile Arg Trp Arg Lys Gly Gln Leu
50 55 60

Ile Gly Arg Gly Ala Phe Gly Thr Val Tyr Met Gly Met Asn Leu Asp
65 70 75 80

Ser Gly Glu Leu Leu Ala Val Lys Gln Ala Leu Ile Thr Ser Asn Cys
85 90 95

Ala Ser Lys Glu Lys Thr Gln Ala His Ile Gln Glu Leu Glu Glu Glu
100 105 110

Val Lys Leu Leu Lys Asn Leu Ser His Pro Asn Ile Val Arg Tyr Leu
115 120 125

Gly Thr Val Arg Glu Asp Glu Thr Leu Asn Ile Leu Leu Glu Phe Val
130 135 140

Pro Gly Gly Ser Ile Ser Ser Leu Leu Glu Lys Phe Gly Ala Phe Pro
145 150 155 160

Glu Ser Val Val Arg Thr Tyr Thr Asn Gln Leu Leu Leu Gly Leu Glu
165 170 175

Tyr Leu His Asn His Ala Ile Met His Arg Asp Ile Lys Gly Ala Asn
180 185 190

Ile Leu Val Asp Asn Gln Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala
 195 200 205

Ser Lys Gln Val Ala Glu Leu Ala Thr Ile Ser Gly Ala Lys Ser Met
 210 215 220

Lys Gly Thr Pro Tyr Trp Met Ala Pro Glu Val Ile Leu Gln Thr Gly
 225 230 235 240

His Ser Phe Ser Ala Asp Ile Trp Ser Val Gly Cys Thr Val Ile Glu
 245 250 255

Met Val Thr Gly Lys Ala Pro Trp Ser Gln Gln Tyr Lys Glu Ile Ala
 260 265 270

Ala Ile Phe His Ile Gly Thr Thr Lys Ser His Pro Pro Ile Pro Asp
 275 280 285

Asn Ile Ser Ser Asp Ala Asn Asp Phe Leu Leu Lys Cys Leu Gln Gln
 290 295 300

Glu Pro Asn Leu Arg Pro Thr Ala Ser Glu Leu Leu Lys His Pro Phe
 305 310 315 320

Val Thr Gly Lys Gln Lys Glu Ser Ala Ser Lys Asp Leu Thr Ser Phe
 325 330 335

Met Asp Asn Ser Cys Ser Pro Leu Pro Ser Glu Leu Thr Asn Ile Thr
 340 345 350

Ser Tyr Gln Thr Ser Thr Ser Asp Asp Val Gly Asp Ile Cys Asn Leu
 355 360 365

Gly Ser Leu Thr Cys Thr Leu Ala Phe Pro Glu Lys Ser Ile Gln Asn
 370 375 380

Asn Ser Leu Cys Leu Lys Ser Asn Asn Gly Tyr Asp Asp Asp Asp Asp
 385 390 395 400

Asn Asp Met Cys Leu Ile Asp Asp Glu Asn Phe Leu Thr Tyr Asn Gly
 405 410 415

Glu Thr Gly Pro Ser Leu Asp Asn Asn Thr Asp Ala Lys Lys Ser Cys
 420 425 430

Asp Thr Met Ser Glu Ile Ser Asp Ile Leu Lys Cys Lys Phe Asp Glu
 435 440 445

Asn Ser Gly Asn Gly Glu Thr Glu Thr Lys Val Ser Met Glu Val Asp
 450 455 460

His Pro Ser Tyr Ser Glu Asp Glu Asn Glu Leu Thr Glu Ser Lys Ile
 465 470 475 480

Lys Ala Phe Leu Asp Asp Lys Ala Ala Glu Leu Lys Lys Leu Gln Thr
 485 490 495

Pro Leu Tyr Glu Glu Phe Tyr Asn Gly Met Ile Thr Cys Ser Pro Ile
 500 505 510

Cys Met Glu Ser Asn Ile Asn Asn Asn Lys Arg Glu Glu Ala Pro Arg
 515 520 525

Gly Phe Leu Lys Leu Pro Pro Lys Ser Arg Ser Pro Ser Gln Gly His
 530 535 540

Ile Gly Arg Ser Pro Ser Arg Ala Thr Asp Ala Ala Cys Cys Ser Lys
 545 550 555 560

Ser Pro Glu Ser Gly Asn Ser Ser Gly Ala Pro Lys Asn Ser Asn Ala
 565 570 575

Ser Ala Gly Ala Glu Gln Glu Ser Asn Ser Gln Ser Val Ala Leu Ser
 580 585 590

Glu Ile Glu Arg Lys Trp Lys Glu Glu Leu Asp Gln Glu Leu Glu Arg
 595 600 605

Lys Arg Arg Glu Ile Thr Arg Gln Ala Gly Met Gly Ser Ser Pro Arg
 610 615 620

Asp Arg Ser Leu Ser Arg His Arg Glu Lys Ser Arg Phe Ala Ser Pro
 625 630 635 640

Gly Lys

<210> 12
 <211> 2193
 <212> DNA
 <213> *Arabidopsis thaliana*

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 aataaacgag aggaggcacc tcgtgggttc ttgaaactgc ctccaaaaag tcggtctccg 1620
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 caacttaaag tttgaatata tatagatagc taaactatct gcttaagtag ggtgtgatgt 2100
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 atcgaaagct ttgtttactt tcgggtccggt ccg 2193

<210> 13
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 <212> PRT
 <213> Arabidopsis thaliana

<400> 13

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Val Lys Gln Ala Leu Ile Thr Ser Asn Cys Ala Ser Lys Glu Lys Thr
 35 40 45

Gln Ala His Ile Gln Glu Leu Glu Glu Glu Val Lys Leu Leu Lys Asn
 50 55 60

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Asp
 65 70 75 80

Glu Thr Leu Asn Ile Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser
 85 90 95

Ser Leu Leu Glu Lys Phe Gly Ala Phe Pro Glu Ser Val Val Arg Thr
 100 105 110

Tyr Thr Asn Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn His Ala
 115 120 125

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Gln
 130 135 140

Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala Ser Lys Gln Val Ala Glu
 145 150 155 160

Leu Ala Thr Ile Ser Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
 165 170 175

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
 180 185 190

Ile Trp Ser Val Gly Cys Thr Val Ile Glu Met Val Thr Gly Lys Ala
 195 200 205

Pro Trp Ser Gln Gln Tyr Lys Glu Ile Ala Ala Ile Phe His Ile Gly
 210 215 220

Thr Thr Lys Ser His Pro Pro Ile Pro Asp Asn Ile Ser Ser Asp Ala
 225 230 235 240

Asn Asp Phe Leu Leu Lys Cys Leu Gln Gln Glu Pro Asn Leu Arg Pro
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 260 265

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 <212> DNA
 <213> Arabidopsis thaliana

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<210> 15
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 <212> PRT
 <213> Arabidopsis thaliana

<400> 15

Met Gln Asp Ile Leu Gly Ser Val Arg Arg Ser Leu Val Phe Arg Ser
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 20 25 30

Val Gly Lys Ile Asn Ser Ser Ile Arg Ser Ser Arg Ile Gly Leu Phe
 35 40 45

Ser Lys Pro Pro Pro Gly Leu Pro Ala Pro Arg Lys Glu Glu Ala Pro
 50 55 60

Ser Ile Arg Trp Arg Lys Gly Glu Leu Ile Gly Cys Gly Ala Phe Gly
 65 70 75 80

Arg Val Tyr Met Gly Met Asn Leu Asp Ser Gly Glu Leu Leu Ala Ile
 85 90 95

Lys Gln Val Leu Ile Ala Pro Ser Ser Ala Ser Lys Glu Lys Thr Gln
 100 105 110

Gly His Ile Arg Glu Leu Glu Glu Glu Val Gln Leu Leu Lys Asn Leu
 115 120 125

Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Ser Asp
 130 135 140

Ser Leu Asn Ile Leu Met Glu Phe Val Pro Gly Gly Ser Ile Ser Ser
 145 150 155 160

Leu Leu Glu Lys Phe Gly Ser Phe Pro Glu Pro Val Ile Ile Met Tyr
 165 170 175

Thr Lys Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn Asn Gly Ile
 180 185 190

Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys Gly
 195 200 205

Cys Ile Arg Leu Ala Asp Phe Gly Ala Ser Lys Lys Val Val Glu Leu
 210 215 220

Ala Thr Val Asn Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp Met
 225 230 235 240

Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp Ile
 245 250 255

Trp Ser Val Gly Cys Thr Val Ile Glu Met Ala Thr Gly Lys Pro Pro
 260 265 270

Trp Ser Glu Gln Tyr Gln Gln Phe Ala Ala Val Leu His Ile Gly Arg
 275 280 285

Thr Lys Ala His Pro Pro Ile Pro Glu Asp Leu Ser Pro Glu Ala Lys
 290 295 300

Asp Phe Leu Met Lys Cys Leu His Lys Glu Pro Ser Leu Arg Leu Ser
 305 310 315 320

Ala Thr Glu Leu Leu Gln His Pro Phe Val Thr Gly Lys Arg Gln Glu
 325 330 335

Pro Tyr Pro Ala Tyr Arg Asn Ser Leu Thr Glu Cys Gly Asn Pro Ile
 340 345 350

Thr Thr Gln Gly Met Asn Val Arg Ser Ser Ile Asn Ser Leu Ile Arg
 355 360 365

Arg Ser Thr Cys Ser Gly Leu Lys Asp Val Cys Glu Leu Gly Ser Leu
 370 375 380

Arg Ser Ser Ile Ile Tyr Pro Gln Lys Ser Asn Asn Ser Gly Phe Gly
 385 390 395 400

Trp Arg Asp Gly Asp Ser Asp Asp Leu Cys Gln Thr Asp Met Asp Asp
 405 410 415

Leu Cys Asn Ile Glu Ser Val Arg Asn Asn Val Leu Ser Gln Ser Thr
 420 425 430

Asp Leu Asn Lys Ser Phe Asn Pro Met Cys Asp Ser Thr Asp Asn Trp
 435 440 445

Ser Cys Lys Phe Asp Glu Ser Pro Lys Val Met Lys Ser Lys Ser Asn
 450 455 460

Leu Leu Ser Tyr Gln Ala Ser Gln Leu Gln Thr Gly Val Pro Cys Asp
 465 470 475 480

Glu Glu Thr Ser Leu Thr Phe Ala Gly Gly Ser Ser Val Ala Glu Asp
 485 490 495

Asp Tyr Lys Gly Thr Glu Leu Lys Ile Lys Ser Phe Leu Asp Glu Lys
 500 505 510

Ala Gln Asp Leu Lys Arg Leu Gln Thr Pro Leu Leu Glu Glu Phe His
 515 520 525

Asn Ala Met Asn Pro Gly Ile Pro Gln Gly Ala Leu Gly Asp Thr Asn
 530 535 540

Ile Tyr Asn Leu Pro Asn Leu Pro Ser Ile Ser Lys Thr Pro Lys Arg
 545 550 555 560

Leu Pro Ser Arg Arg Leu Ser Ala Ile Ser Asp Ala Met Pro Ser Pro

565

570

575

Leu Lys Ser Ser Lys Arg Thr Leu Asn Thr Ser Arg Val Met Gln Ser
580 585 590

Gly Thr Glu Pro Thr Gln Val Asn Glu Ser Thr Lys Lys Gly Val Asn
595 600 605

Asn Ser Arg Cys Phe Ser Glu Ile Arg Arg Lys Trp Glu Glu Glu Leu
610 615 620

Tyr Glu Glu Leu Glu Arg His Arg Glu Asn Leu Arg His Ala Gly Ala
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Gly Gly Lys Thr Pro Leu Ser Gly His Lys Gly
645 650

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<211> 2157
<212> DNA
<213> Arabidopsis thaliana

<400> 16
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gaggtcttag cggattcgtc ggggaagatta actctagtat ccgtagctct cgaattgggc 180
tcttttctaa gccgcctcca gggcttctg ctctagaaa agaagaagcg ccgtcgattc 240
gggtggaggaa aggggaatta atcggttgct gtgcttttgg aagagtttac atgggaatga 300
acctcgattc cggcgagctt cttgcaatta aacaggtttt aatcgctcca agcagtgtt 360
caaaggagaa gactcagggt cacatccgag agcttgagga agaagtacaa cttcttaaga 420
atctttcaca tccgaacatc gttagatact tgggtactgt aagagagagt gattcgttga 480
atattttgat ggagtttgtt cctggtggat caatatcatc tttgttggag aagtttggat 540
cttttctga gcctgtgatt attatgtaca caaagcaact tctgcttggg ctggaatata 600
ttcacaacaa tgggatcatg catcgagata ttaagggggc aaatattttg gtcgataaca 660
aaggttgcac cagactcgca gattttggtg cttccaagaa agttgtagag ctagctactg 720
taaagtgtgc caaatctatg aaggggacgc cttattggat ggctcctgaa gtcattctcc 780
agactggtca tagcttctct gctgatatat ggagtgttgg gtgcactgtg attgagatgg 840

ctacggggaa gcctccctgg agcgagcagt atcagcagtt tgctgctgtc cttcatattg 900
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 ttttgtcaca gtccaccgat ttaaacaaga gttttaatcc catgtgtgat tccacggata 1380
 actggtcttg caagtttgat gaaagcccaa aagtgatgaa aagcaaactc aacctgcttt 1440
 cttaccaagc ttctcaactc caaactggag ttccatgtga tgaggaaacc agcttaacat 1500
 ttgctgggtg ctcttcctgt gcagaggatg attataaagg cacagagttg aaaataaaat 1560
 catttttggg tgagaaggct caggatttga aaaggttgca gaccctctg cttgaagaat 1620
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 gcagagtgat gcagtcagga actgaaccaa ctcaagtcaa cgagtcgacc aagaaggagg 1860
 taaataatag ccgttgtttc tcagagatac gtcggaagtg ggaagaagaa ctctatgaag 1920
 agcttgagag gcatcgagag aatctgagac acgctggtgc aggagggaag actccattat 1980
 caggccacaa aggatagtga acggctaaag agaaactgta tgtttctttc ttatgtttca 2040
 aaattacttc ttcgtatttt tttttgttgg tggggtaatt tcatgagcta gtatgatata 2100
 tgtagatagt tcttcaacgg ttacatagta ttattattta ttattaattt aattgcc 2157

<210> 17
 <211> 268
 <212> PRT
 <213> *Arabidopsis thaliana*

<400> 17

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Gly Arg Val Tyr Met Gly Met Asn Leu Asp Ser Gly Glu Leu Leu Ala

20

25

30

Ile Lys Gln Val Leu Ile Ala Pro Ser Ser Ala Ser Lys Glu Lys Thr
35 40 45

Gln Gly His Ile Arg Glu Leu Glu Glu Glu Val Gln Leu Leu Lys Asn
50 55 60

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Ser
65 70 75 80

Asp Ser Leu Asn Ile Leu Met Glu Phe Val Pro Gly Gly Ser Ile Ser
85 90 95

Ser Leu Leu Glu Lys Phe Gly Ser Phe Pro Glu Pro Val Ile Ile Met
100 105 110

Tyr Thr Lys Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn Asn Gly
115 120 125

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys
130 135 140

Gly Cys Ile Arg Leu Ala Asp Phe Gly Ala Ser Lys Lys Val Val Glu
145 150 155 160

Leu Ala Thr Val Asn Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
165 170 175

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
180 185 190

Ile Trp Ser Val Gly Cys Thr Val Ile Glu Met Ala Thr Gly Lys Pro
195 200 205

Pro Trp Ser Glu Gln Tyr Gln Gln Phe Ala Ala Val Leu His Ile Gly
210 215 220

Arg Thr Lys Ala His Pro Pro Ile Pro Glu Asp Leu Ser Pro Glu Ala
225 230 235 240

Lys Asp Phe Leu Met Lys Cys Leu His Lys Glu Pro Ser Leu Arg Leu
245 250 255

Ser Ala Thr Glu Leu Leu Gln His Pro Phe Val Thr
 260 265

<210> 18
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 <212> DNA
 <213> Arabidopsis thaliana

<400> 18
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 agcagtgctt caaaggagaa gactcagggt cacatccgag agcttgagga agaagtacaa 180
 cttcttaaga atctttcaca tccgaacatc gttagatact tgggtactgt aagagagagt 240
 gattcgttga atattttgat ggagtttggt cctgggtggat caatatcatc tttgttgag 300
 aagtttggat cttttcctga gcctgtgatt attatgtaca caaagcaact tctgcttggg 360
 ctggaatata ttcacaacaa tgggatcatg catcgagata ttaagggggc aaatattttg 420
 gtcgataaca aagggttgcag cagactcgca gattttggtg cttccaagaa agttgtagag 480
 ctagctactg taaatggtgc caaatctatg aaggggacgc cttattggat ggctcctgaa 540
 gtcattctcc agactggtca tagcttctct gctgatatat ggagtgttgg gtgcactgtg 600
 attgagatgg ctacggggaa gcctccctgg agcgagcagt atcagcagtt tgctgctgtc 660
 cttcatattg gtagaacaaa agctcatcct ccaattccag aagacctctc accagaggct 720
 aaagactttc taatgaaatg cttacacaaa gaaccaagct tgagactctc tgcaaccgaa 780
 ttgcttcagc acccgtttgt cact 804

<210> 19
 <211> 690
 <212> PRT
 <213> Nicotiana tabacum

<400> 19

Met Gln Asp Phe Ile Gly Ser Val Arg Arg Ser Leu Val Phe Lys Gln
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Ser Gly Asp Phe Asp Thr Gly Ala Ala Gly Val Gly Ser Gly Phe Gly
 20 25 30

Gly Phe Val Glu Lys Leu Gly Ser Ser Ile Arg Lys Ser Ser Ile Gly

35

40

45

Ile Phe Ser Lys Ala His Val Pro Ala Leu Pro Ser Ile Ser Lys Ala
50 55 60

Glu Leu Pro Ala Lys Ala Arg Lys Asp Asp Thr Pro Pro Ile Arg Trp
65 70 75 80

Arg Lys Gly Glu Met Ile Gly Cys Gly Ala Phe Gly Arg Val Tyr Met
85 90 95

Gly Met Asn Val Asp Ser Gly Glu Leu Leu Ala Ile Lys Glu Val Ser
100 105 110

Ile Ala Met Asn Gly Ala Ser Arg Glu Arg Ala Gln Ala His Val Arg
115 120 125

Glu Leu Glu Glu Glu Val Asn Leu Leu Lys Asn Leu Ser His Pro Asn
130 135 140

Ile Val Arg Tyr Leu Gly Thr Ala Arg Glu Ala Gly Ser Leu Asn Ile
145 150 155 160

Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser Ser Leu Leu Gly Lys
165 170 175

Phe Gly Ser Phe Pro Glu Ser Val Ile Arg Met Tyr Thr Lys Gln Leu
180 185 190

Leu Leu Gly Leu Glu Tyr Leu His Lys Asn Gly Ile Met His Arg Asp
195 200 205

Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys Gly Cys Ile Lys Leu
210 215 220

Ala Asp Phe Gly Ala Ser Lys Lys Val Val Glu Leu Ala Thr Met Thr
225 230 235 240

Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp Met Ala Pro Glu Val
245 250 255

Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp Ile Trp Ser Val Gly
260 265 270

Cys Thr Ile Ile Glu Met Ala Thr Gly Lys Pro Pro Trp Ser Gln Gln
 275 280 285

Tyr Gln Glu Val Ala Ala Leu Phe His Ile Gly Thr Thr Lys Ser His
 290 295 300

Pro Pro Ile Pro Glu His Leu Ser Ala Glu Ser Lys Asp Phe Leu Leu
 305 310 315 320

Lys Cys Leu Gln Lys Glu Pro His Leu Arg His Ser Ala Ser Asn Leu
 325 330 335

Leu Gln His Pro Phe Val Thr Ala Glu His Gln Glu Ala Arg Pro Phe
 340 345 350

Leu Arg Ser Ser Phe Met Gly Asn Pro Glu Asn Met Ala Ala Gln Arg
 355 360 365

Met Asp Val Arg Thr Ser Ile Ile Pro Asp Met Arg Ala Ser Cys Asn
 370 375 380

Gly Leu Lys Asp Val Cys Gly Val Ser Ala Val Arg Cys Ser Thr Val
 385 390 395 400

Tyr Pro Glu Asn Ser Leu Gly Lys Glu Ser Leu Trp Lys Leu Gly Asn
 405 410 415

Ser Asp Asp Asp Met Cys Gln Met Asp Asn Asp Asp Phe Met Phe Gly
 420 425 430

Ala Ser Val Lys Cys Ser Ser Asp Leu His Ser Pro Ala Asn Tyr Lys
 435 440 445

Ser Phe Asn Pro Met Cys Glu Pro Asp Asn Asp Trp Pro Cys Lys Phe
 450 455 460

Asp Glu Ser Pro Glu Leu Thr Lys Ser Gln Ala Asn Leu His Tyr Asp
 465 470 475 480

Gln Ala Thr Ile Lys Pro Thr Asn Asn Pro Ile Met Ser Tyr Lys Glu
 485 490 495

Asp Leu Ala Phe Thr Phe Pro Ser Gly Gln Ser Ala Ala Glu Asp Asp
500 505 510

Asp Glu Leu Thr Glu Ser Lys Ile Arg Ala Phe Leu Asp Glu Lys Ala
515 520 525

Met Asp Leu Lys Lys Leu Gln Thr Pro Leu Tyr Glu Gly Phe Tyr Asn
530 535 540

Ser Leu Asn Val Ser Ser Thr Pro Ser Pro Val Gly Thr Gly Asn Lys
545 550 555 560

Glu Asn Val Pro Ser Asn Ile Asn Leu Pro Pro Lys Ser Arg Ser Pro
565 570 575

Lys Arg Met Leu Ser Arg Arg Leu Ser Thr Ala Ile Glu Gly Ala Cys
580 585 590

Ala Pro Ser Pro Val Thr His Ser Lys Arg Ile Ser Asn Ile Gly Gly
595 600 605

Leu Asn Gly Glu Ala Ile Gln Glu Ala Gln Leu Pro Arg His Asn Glu
610 615 620

Trp Lys Asp Leu Leu Gly Ser Gln Arg Glu Ala Val Asn Ser Ser Phe
625 630 635 640

Ser Glu Arg Gln Arg Arg Trp Lys Glu Glu Leu Asp Glu Glu Leu Gln
645 650 655

Arg Lys Arg Glu Ile Met Arg Gln Ala Val Asn Leu Ser Pro Pro Lys
660 665 670

Asp Pro Ile Leu Asn Arg Cys Arg Ser Lys Ser Arg Phe Ala Ser Pro
675 680 685

Gly Arg
690

<210> 20
<211> 2527
<212> DNA
<213> Nicotiana tabacum

<400> 20

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cgctgccggt gtcggcagcg gattcggagg cttcgttgag aaactaggtt cgagcattcg	180
caaatcgagt attggaatct tctcgaaagc tcatgttctt gctcttccgt ctattttctaa	240
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agagttactc gctataaagg aggtttcgat tgcgatgaat ggtgcttcga gagagcgagc	420
acaagctcat gttagagagc ttgaggaaga agtgaatcta ttgaagaatc tctcccatcc	480
caacatagtg agatatttgg gaactgcaag agaggcagga tcattaaata tattgttgga	540
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tgttataaga atgtacacca agcaattggt attagggttg gaatacttgc ataagaatgg	660
gattatgcac agagatatta agggagcaaa catacttggt gacaataaag gttgcattaa	720
acttgctgat ttcggtgcat ccaagaaggt tgttgaattg gctactatga ctggtgccaa	780
gtcaatgaag ggtactccat actggatggc tcccgaagtc attctgcaga ctggccatag	840
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gcagaaggaa ccgcacctga ggcattctgc atcaaatttg cttcagcatc catttgttac	1080
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caatggtttg aaagatgttt gtggtgttag cgctgtgagg tgctccactg tatatcccga	1260
gaattcctta gggaaagagt cactctggaa actaggaaac tctgatgatg acatgtgcca	1320
gatggataat gatgatttta tgtttggtgc atctgtgaaa tgcagttcag atttgcatte	1380
tcctgctaata tataagagtt ttaatcctat gtgtgaacct gataacgatt ggccatgcaa	1440
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tattaagccc actaataacc ccatcatgtc atacaaggag gatcttgctt tcacatttcc	1560
aagtgggcaa tctgcagccg aggatgatga tgaattgaca gagtctaaaa ttagggcatt	1620
ccttgatgaa aaggcaatgg acttgaagaa gctgcaaaca ccactatatg aaggattcta	1680

caattccttg aatgtttcca gcacaccgag tcccgttggc actgggaaca aggaaaatgt 1740
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 gcaaagaagg tggaagaag agcttgatga agagttgcaa aggaaacgag agattatgcg 2040
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 aaggtttgca tctcctggaa gataaatgta tgtacttgtg tccctaaact aaagtcagtt 2160
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 ttttataacc tatataagtg ctctctcatg gtagttgcca atattaaaac gcagagaaaa 2460
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 tacaacc 2527

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 <211> 268
 <212> PRT
 <213> *Nicotiana tabacum*
 <400> 21

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Gly Arg Val Tyr Met Gly Met Asn Val Asp Ser Gly Glu Leu Leu Ala
 20 25 30

Ile Lys Glu Val Ser Ile Ala Met Asn Gly Ala Ser Arg Glu Arg Ala
 35 40 45

Gln Ala His Val Arg Glu Leu Glu Glu Val Asn Leu Leu Lys Asn
 50 55 60

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Ala Arg Glu Ala
 65 70 75 80

Gly Ser Leu Asn Ile Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser
85 90 95

Ser Leu Leu Gly Lys Phe Gly Ser Phe Pro Glu Ser Val Ile Arg Met
100 105 110

Tyr Thr Lys Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Lys Asn Gly
115 120 125

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys
130 135 140

Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala Ser Lys Lys Val Val Glu
145 150 155 160

Leu Ala Thr Met Thr Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
165 170 175

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
180 185 190

Ile Trp Ser Val Gly Cys Thr Ile Ile Glu Met Ala Thr Gly Lys Pro
195 200 205

Pro Trp Ser Gln Gln Tyr Gln Glu Val Ala Ala Leu Phe His Ile Gly
210 215 220

Thr Thr Lys Ser His Pro Pro Ile Pro Glu His Leu Ser Ala Glu Ser
225 230 235 240

Lys Asp Phe Leu Leu Lys Cys Leu Gln Lys Glu Pro His Leu Arg His
245 250 255

Ser Ala Ser Asn Leu Leu Gln His Pro Phe Val Thr
260 265

<210> 22
<211> 804
<212> DNA
<213> Nicotiana Tabacum

<400> 22
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 aatggtgctt cgagagagcg agcacaagct catgttagag agcttgagga agaagtgaat 180
 ctattgaaga atctctccca tcccaacata gtgagatatt tgggaactgc aagagaggca 240
 ggatcattaa atatattggtt ggaatttggtt cctggtggct caatctcgtc acttttggga 300
 aaatttggat ccttcctga atctgttata agaatgtaca ccaagcaatt gttattaggg 360
 ttggaatact tgcataagaa tgggattatg cacagagata ttaagggagc aaacatactt 420
 gttgacaata aaggttgcatt taaacttgct gatttcggtg catccaagaa gggtgttgaa 480
 ttggtacta tgactggtgc caagtcaatg aagggtactc catactggat ggctcccgaa 540
 gtcattctgc agactggcca tagcttctct gctgacatat ggagtgtcgg atgcactatt 600
 atcgaaatgg ctacaggaaa acctccttgg agccagcagt atcaggaggt tgctgctctc 660
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 aaggacttcc tattaataatg tttgcagaag gaaccgcacc tgaggcattc tgcataaat 780
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<210> 23
 <211> 666
 <212> PRT
 <213> Arabidopsis thaliana

<400> 23

Met Gln Asp Phe Phe Gly Ser Val Arg Arg Ser Leu Val Phe Arg Pro
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Ser Ser Asp Asp Asp Asn Gln Glu Asn Gln Pro Pro Phe Pro Gly Val
 20 25 30

Leu Ala Asp Lys Ile Thr Ser Cys Ile Arg Lys Ser Lys Ile Phe Ile
 35 40 45

Lys Pro Ser Phe Ser Pro Pro Pro Ala Asn Thr Val Asp Met Ala
 50 55 60

Pro Pro Ile Ser Trp Arg Lys Gly Gln Leu Ile Gly Arg Gly Ala Phe
 65 70 75 80

Gly Thr Val Tyr Met Gly Met Asn Leu Asp Ser Gly Glu Leu Leu Ala
 85 90 95

Val Lys Gln Val Leu Ile Ala Ala Asn Phe Ala Ser Lys Glu Lys Thr
100 105 110

Gln Ala His Ile Gln Glu Leu Glu Glu Glu Val Lys Leu Leu Lys Asn
115 120 125

Leu Ser His Pro Asn Ile Val Arg Tyr Leu Gly Thr Val Arg Glu Asp
130 135 140

Asp Thr Leu Asn Ile Leu Leu Glu Phe Val Pro Gly Gly Ser Ile Ser
145 150 155 160

Ser Leu Leu Glu Lys Phe Gly Pro Phe Pro Glu Ser Val Val Arg Thr
165 170 175

Tyr Thr Arg Gln Leu Leu Leu Gly Leu Glu Tyr Leu His Asn His Ala
180 185 190

Ile Met His Arg Asp Ile Lys Gly Ala Asn Ile Leu Val Asp Asn Lys
195 200 205

Gly Cys Ile Lys Leu Ala Asp Phe Gly Ala Ser Lys Gln Val Ala Glu
210 215 220

Leu Ala Thr Met Thr Gly Ala Lys Ser Met Lys Gly Thr Pro Tyr Trp
225 230 235 240

Met Ala Pro Glu Val Ile Leu Gln Thr Gly His Ser Phe Ser Ala Asp
245 250 255

Ile Trp Ser Val Gly Cys Thr Val Ile Glu Met Val Thr Gly Lys Ala
260 265 270

Pro Trp Ser Gln Gln Tyr Lys Glu Val Ala Ala Ile Phe Phe Ile Gly
275 280 285

Thr Thr Lys Ser His Pro Pro Ile Pro Asp Thr Leu Ser Ser Asp Ala
290 295 300

Lys Asp Phe Leu Leu Lys Cys Leu Gln Glu Val Pro Asn Leu Arg Pro
305 310 315 320

Thr Ala Ser Glu Leu Leu Lys His Pro Phe Val Met Gly Lys His Lys
 325 330 335

Glu Ser Ala Ser Thr Asp Leu Gly Ser Val Leu Asn Asn Leu Ser Thr
 340 345 350

Pro Leu Pro Leu Gln Ile Asn Asn Thr Lys Ser Thr Pro Asp Ser Thr
 355 360 365

Cys Asp Asp Val Gly Asp Met Cys Asn Phe Gly Ser Leu Asn Tyr Ser
 370 375 380

Leu Val Asp Pro Val Lys Ser Ile Gln Asn Lys Asn Leu Trp Gln Gln
 385 390 395 400

Asn Asp Asn Gly Gly Asp Glu Asp Asp Met Cys Leu Ile Asp Asp Glu
 405 410 415

Asn Phe Leu Thr Phe Asp Gly Glu Met Ser Ser Thr Leu Glu Lys Asp
 420 425 430

Cys His Leu Lys Lys Ser Cys Asp Asp Ile Ser Asp Met Ser Ile Ala
 435 440 445

Leu Lys Ser Lys Phe Asp Glu Ser Pro Gly Asn Gly Glu Lys Glu Ser
 450 455 460

Thr Met Ser Met Glu Cys Asp Gln Pro Ser Tyr Ser Glu Asp Asp Asp
 465 470 475 480

Glu Leu Thr Glu Ser Lys Ile Lys Ala Phe Leu Asp Glu Lys Ala Ala
 485 490 495

Asp Leu Lys Lys Leu Gln Thr Pro Leu Tyr Glu Glu Phe Tyr Asn Ser
 500 505 510

Leu Ile Thr Phe Ser Pro Ser Cys Met Glu Ser Asn Leu Ser Asn Ser
 515 520 525

Lys Arg Glu Asp Thr Ala Arg Gly Phe Leu Lys Leu Pro Pro Lys Ser
 530 535 540

Arg Ser Pro Ser Arg Gly Pro Leu Gly Gly Ser Pro Ser Arg Ala Thr
 545 550 555 560

Asp Ala Thr Ser Cys Ser Lys Ser Pro Gly Ser Gly Gly Ser Arg Glu
 565 570 575

Leu Asn Ile Asn Asn Gly Gly Asp Glu Ala Ser Gln Asp Gly Val Ser
 580 585 590

Ala Arg Val Thr Asp Trp Arg Gly Leu Val Val Asp Thr Lys Gln Glu
 595 600 605

Leu Ser Gln Cys Val Ala Leu Ser Glu Ile Glu Lys Lys Trp Lys Glu
 610 615 620

Glu Leu Asp Gln Glu Leu Glu Arg Lys Arg Gln Glu Ile Met Arg Gln
 625 630 635 640

Ala Gly Leu Gly Ser Ser Pro Arg Asp Arg Gly Met Ser Arg Gln Arg
 645 650 655

Glu Lys Ser Arg Phe Ala Ser Pro Gly Lys
 660 665

<210> 24
 <211> 5
 <212> PRT
 <213> Arabidopsis thaliana

<400> 24

Met Met Arg Ile Ser
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